

WHAT IS CLAIMED IS:

1. An electrotherapy apparatus comprising:
an electric energy storage section generating a stimulation pulse, and
an output electrode for applying the stimulation pulse to a patient;
means for reversing polarity of the voltage outputted to the output electrode, and outputting at least first phase waveform and second phase waveform to the output electrode, controlling the shape of the second phase waveform.

2. An electrotherapy apparatus comprising:
an electric energy storage section generating a stimulation pulse;
an output electrode for applying the stimulation pulse to a patient;
means for reversing polarity of the voltage outputted to the output electrode, and outputting at least first phase waveform and second phase waveform to the output electrode, a predetermined electric energy being delivered within a predetermined time period in the second phase waveform.

3. An electrotherapy apparatus according to Claim 2, further comprising:

control means for controlling the apparatus such that the electric power of the electric energy outputted from the output electrode becomes constant without depending on a value of the impedance of the patient during the output period of the second phase waveform.

4. An electrotherapy apparatus according to Claim 3, wherein the control means controls the output so that the value relating to the voltage, which is lowered corresponding to the amount of the energy supplied from the electric energy storage section, changes corresponding to a function of the predetermined time period and the value relating to the voltage.

5. An electrotherapy apparatus according to Claim 4, wherein the value relating to the voltage is one of a voltage value, voltage differential value, and voltage double differential value.

6. An electrotherapy apparatus according to Claim 3, wherein the control means controls the output so that the value relating to the current, which varies corresponding to the amount of the energy supplied from the electric energy storage section, changes corresponding to a function of the predetermined time period and the value relating to the current.

1 7. An electrotherapy apparatus according to Claim 6, wherein
2 the value relating to the current corresponds to one of a current
3 value, current differential value, and current double differential
4 value.

1 8. An electrotherapy apparatus according to Claim 2 further
2 comprising:

3 patient parameter measuring means for measuring the patient
4 parameter;

5 output electrode parameter measuring means for measuring the
6 voltage generated between the output electrodes, or the current
7 flowing to the output electrode; and

8 control means for controlling the apparatus such that the
9 electric power of the electric energy becomes constant without
10 depending on a value of the patient impedance on the basis of the
11 patient parameter measured by the patient parameter measuring means
12 before the second phase waveform is outputted and a value, which
13 relates to the voltage between the output electrodes or the current
14 flowing to the output electrode, measured by the output electrode
15 parameter measuring means during the output of the second phase
16 waveform.

1 9. An electrotherapy apparatus according to Claim 2, further
2 comprising:

3 an inductor;

an electric energy storage section;

first switch means for connecting the electric energy storage section,

wherein when the waveform of the electric energy outputted from the output electrode is the first phase waveform, an inductor, electric energy storage section, the first switch means, the output electrode, patient, and at least, another output electrode are connected to form a closed circuit,

wherein in the case where the waveform of the electric energy outputted from the output electrode is the second phase waveform, when the first switch means is closed, the inductor and the electric energy storage section without the patient form the closed circuit; and

wherein when the first switch means is opened, the inductor and the electric energy storage section are electrically separated, and the electric energy is delivered from the inductor to the output electrode.

10. An electrotherapy apparatus according to Claim 9, wherein the shape of the second phase waveform can be controlled by switching the first switch means.

11. An electrotherapy apparatus according to Claim 9, further comprising:

second switch means and third switch means for shaping the

4 first phase waveform and the second phase waveform of the electric
5 energy outputted from the output electrode.

1 12. An electrotherapy apparatus according to Claim 11, wherein
2 the first switch means, second switch means and third switch means
3 are structured by semiconductor switches.

1 13. An electrotherapy apparatus comprising:

2 an electric energy storage section generating a stimulation
3 pulse;

4 an output electrode for applying the stimulation pulse to
5 a patient; and

6 control means for controlling the shape of the waveform of
7 the stimulation pulse such that the predetermined electric energy
8 stored in the electric energy storage section is outputted to the
9 output electrode through an electric circuit within a predetermined
10 time period.

1 14. An electrotherapy apparatus according to Claim 13, wherein
2 the control means controls the shape of the waveform of the
3 stimulation pulse in such a manner that the electric power of the
4 electric energy applied from the electrode becomes constant without
5 depending on the value of the impedance of the patient.

1 15. An electrotherapy apparatus according to Claim 14, wherein
2 the control means controls the output in such a manner that the
3 value relating to the voltage which is lowered corresponding to
4 the amount of the energy supplied from the electric energy storage
5 section changes corresponding to a function of the predetermined
6 time period and the value relating to the voltage.

1 16. An electrotherapy apparatus according to Claim 15, wherein
2 the value relating to the voltage is one of a voltage value, voltage
3 differential value, and voltage double differential value.

1 17. An electrotherapy apparatus according to Claim 14, wherein
2 the control means controls the output in such a manner that the
3 value relating to the current which varies corresponding to the
4 amount of the energy supplied from the electric energy storage
5 section changes corresponding to a function of the predetermined
6 time period and the value relating to the current.

1 18. An electrotherapy apparatus according to Claim 17, wherein
2 the value relating to the current is one of a current value, current
3 differential value, and current double differential value.

1 19. An electrotherapy apparatus according to Claim 13, further
2 comprising:

3 patient parameter measuring means for measuring the patient

4 parameter;

5 output electrode parameter measuring means for measuring the
6 voltage generated between the output electrodes, or the current
7 flowing to the output electrode; and

8 control means for controlling the apparatus such that the
9 electric power of the electric energy becomes constant without
10 depending on a value of the patient impedance on the basis of the
11 patient parameter measured by the patient parameter measuring means
12 before the second phase waveform is outputted and a value, which
13 relates to the voltage between the output electrodes or the current
14 flowing to the output electrode, measured by the output electrode
15 parameter measuring means during the output of the second phase
16 waveform.

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19 20. An electrotherapy apparatus comprising:

2 an electric energy storage section generating a stimulation
3 pulse;

4 an output electrode for applying the stimulation pulse to
5 a patient; and

6 control means for controlling the shape of the waveform of
7 the stimulation pulse in such a manner that the predetermined
8 electric energy stored in the electric energy storage section is
9 outputted to the output electrode through an electric circuit
10 within a predetermined time period,

11 wherein the electric circuit has a switch to control the shape

12 of the waveform of the stimulation pulse, and the control means
13 makes the switch conduct the continuous switching operation by the
14 pulse width modulation control during a period in which the
15 stimulation pulse is applied to the patient.

1 21. An electrotherapy apparatus according to Claim 20, wherein
2 the control means has a reference curve to form the shape of the
3 waveform of the stimulation pulse into the predetermined shape.

4 22. An electrotherapy apparatus according to Claim 21, wherein
5 the control means controls the switching operation of the switch
6 on the basis of the difference between the reference curve and the
7 value relating to the voltage which is lowered corresponding to
8 the amount of energy supplied from the energy storage section.

9 23. An electrotherapy apparatus according to Claim 21, wherein
10 the control means controls the switching operation of the switch
11 according to the difference between the reference curve and the
12 value relating to the current which varies corresponding to the
13 amount of energy supplied from the energy storage section.

14 24. An electrotherapy apparatus according to claim 20, wherein
15 the control means controls so that the electric power of the electric
16 energy applied from the output electrode becomes constant without
17 depending on the value of the impedance of the patient.

1 25. An electrotherapy apparatus according to Claim 21, further
2 comprising:

3 patient parameter measuring means for measuring the patient
4 parameter; and

5 output electrode parameter measuring means for measuring the
6 voltage generated between the output electrodes or the current
7 flowing to the output electrode, and

8 wherein control means controls the switching operation of
9 the switch on the basis of the patient parameter measured before
10 the stimulation pulse is outputted by the patient parameter
11 measuring means and a value, relating to the voltage between output
12 electrodes or the current flowing to the output electrode, measured
13 during the output of the stimulation pulse by the output electrode
14 parameter measuring means.

1 26. An electrotherapy apparatus according to Claim 25, wherein
2 the control means controls in such a manner that the electric power
3 of the electric energy applied from the output electrode becomes
4 constant.

1 27. An electrotherapy apparatus comprising:

2 an inductor section for storing magnetic energy to generate
3 a stimulation pulse;

4 an output electrode for applying the stimulation pulse to
5 a patient; and

6 control means for controlling the shape of the waveform of
7 the stimulation pulse in such a manner that a predetermined energy
8 in the energy stored in the inductor section is delivered to the
9 patient through the output electrode .

1 28. An electrotherapy apparatus according to Claim 27, wherein
2 the apparatus has an electric energy storage section to store the
3 energy in order to supply the energy to the inductor section..

4 29. An electrotherapy apparatus according to Claim 28, wherein
5 the energy storage section is a capacitor, and when the energy stored
6 in the inductor section is supplied to the output electrode, the
control means can control in such a manner that the absolute value
of the output is higher than the absolute value of the voltage stored
in the capacitor.

1 30. An electrotherapy apparatus according to Claim 28, wherein
2 the inductor section is connected to the electric energy storage
3 section through first switch means which is repeatedly switchable,
4 and the control means controls the repeated switching of the first
5 switch means.

1 31. An electrotherapy apparatus according to Claim 30, wherein
2 the control means controls the switching of the first switch means
3 by a pulse width modulation control.

1 32. An electrotherapy apparatus according to Claim 27, wherein
2 the control means controls the shape of the waveform of the
3 stimulation pulse in such manner that the electric power of the
4 electric energy applied from the output electrode becomes constant
5 without depending on the value of the impedance of the patient.

1 33. An electrotherapy apparatus according to Claim 27, wherein
2 the control means has a reference curve in order to form the shape
3 of waveform of the stimulation pulse into the predetermined shape.

1 34. An electrotherapy apparatus according to Claim 33, wherein
2 the control means controls the switching operation of the switch
3 according to the difference between the reference curve and the
4 value relating to the voltage which is lowered corresponding to
5 the amount of energy supplied from the energy storage section.

1 35. An electrotherapy apparatus according to Claim 33, wherein
2 the control means controls the switching operation of the switch
3 on the basis of the difference between the reference curve and the
4 value relating to the current which varies corresponding to the
5 amount of energy supplied from the energy storage section.

1 36. An electrotherapy apparatus according to Claim 2, further
2 comprising:

3 a charging circuit for charging the energy storage section.

1 37. An electrotherapy apparatus comprising:
2 a positive polarity of an electric energy storage section
3 (104) connected to an inductor (105) through first switch means
4 (101), and from the opposite side terminal of the inductor (105),
5 connected to the negative polarity of the electric energy storage
6 section (104) through third switch means (103);
7 the opposite side terminal of the inductor (105) connected
8 to an output electrode (112a) to apply an electric pulse on a
9 patient (113) through an inductor (110); and an output electrode
10 (112b) connected to the negative polarity of the electric energy
11 storage section (104); and
12 a diode (108) and a diode (109) connected in series between
13 the first switch means (101) and the inductor (110), in which the
14 inductor (110) side is an anode, and the first switch means (101)
15 side is a cathode; and
16 a capacitor (106) and a resistor (107) inserted between the
17 diode (108) and the diode (109), and between the inductor (105)
18 and a switch (102); and
19 a protective resistor (111) inserted between the output
20 electrode (112a) and the output electrode (112b); and a charging
21 circuit (115) to charge the electric energy storage section (104);
22 and in which a diode (117) and a diode (118) are respectively
23 inserted between both polarities of the energy storage section
24 (104) and the charging circuit (115); a voltage monitoring circuit
25 (114) connected across both polarities of the energy storage

26 section (104); and a drive circuit (119) to control the open/close
27 operation of the first switch means (101); a drive circuit (120)
28 to control the open/close operation of second switch means (102);
29 and a drive circuit (121) to control the open/close operation of
30 the third switch means (103); and the drive circuit (119), the drive
31 circuit (120), the drive circuit (121) and the charging circuit
32 (115) structured so that these can be controlled by a microprocessor
33 (116).

38. An electrotherapy apparatus as claimed in claim 37, further
comprising:

a current monitoring circuit (131) inserted between the
positive polarity of the electric energy storage section (104) and
the first switch means (101);

a resistor (132) inserted such that the resistor connects
a portion between the current monitoring circuit (131) and the first
switch means (101) to a portion between the inductor (105) and the
second switch means (102); and

the microprocessor (116) at least has a ROM (141) in which
the data of the reference curve is previously stored, and a
digital/analog conversion circuit (140) to convert the data of the
ROM (141) into the analog data;

a gain switching circuit (133), and a pulse width modulation
circuit (143) housing therein at least an error amplifier (142);

a pulse width modulation circuit (143) connected such that

17 a voltage signal (138) from the digital/analog conversion circuit
18 (140) and a voltage signal (137) from a gain switching circuit (133)
19 are inputted thereto; and

20 the gain switching circuit (133) connected such that a control
21 signal (136) from the microprocessor (116), a signal (135) from
22 the current monitoring circuit (131), and a signal (134) from the
23 voltage monitoring circuit (114) are inputted thereto.

15 39. An electrotherapy apparatus according to Claim 2, wherein
16 the apparatus is applied to an external type which applies the
17 stimulation pulse onto the body surface of the patient.
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19 40. An electric energy delivering method of the electrotherapy
20 apparatus when the electric energy stored in the electric energy
21 storage section is delivered to a patient in biphasic waveform
22 comprising:
23

4 delivering a necessary electric energy in a first phase
5 waveform;
6

7 delivering the necessary electric energy within a
8 predetermined time period from the remaining energy in a second
9 phase waveform.

1 41. An electric energy delivering method of the electrotherapy
2 apparatus according to Claim 40, wherein the electric energy stored
3 in the electric energy storage section is delivered to the patient

4 in the first phase waveform and the second phase waveform by
5 alternately repeating a plurality of times, and is formed into a
6 multiphase output waveform.

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